

ORIGINAL ARTICLE

Two new species of the genus *Boysidia* from China, with a preliminary discussion of its geography (Pulmonata: Stylommatophora: Pupillidae)

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Abstract Two species of the genus *Boysidia* Ancey, 1881 were reported as new to science, *Boysidia* (*Boysidia*) *xianfengensis* **sp. nov.** and *B. (B.) xiaoguanensis* **sp. nov.**, while the distribution of the 23 species of *Boysidia* from China was discussed. The materials of the new species were collected from Hubei Province, China by authors. The shell of *B. (B.) xianfengensis* **sp. nov.** looks small (height 4.90 mm, diameter 3.10 mm), and has five apertural teeth: one large parietal tooth, one long columellar tooth, one small nipple-shaped upper palatal tooth, one large flake-shaped lower palatal tooth, one small infrapalatal tooth. The shell of *B. (B.) xiaoguanensis* **sp. nov.** looks small (height 3.55 mm, diameter 2.20 mm), and has four apertural teeth: one large parietal tooth, one long columellar tooth, one large flake-shaped upper palatal tooth, one slightly small flake-shaped lower palatal tooth. The type specimens of the new species are deposited in the Institute of Zoology, Chinese Academy of Sciences, China.

Key words Land snail, *Boysidia*, taxonomy, new species.

1 Introduction

The genus *Boysidia* Ancey, 1881 is a small group in Pupillidae Turton, 1831 and distributed in South Asia, East Asia and Southeast Asia (Ancey, 1881; Baker, 1935; Haas, 1937; Panha & Burch, 2004–2005; Pilsbry, 1916–1918; Pokryszko, 1996; Thompson & Dance, 1983). A total of 3 subgenera, 21 species (Yen, 1939; Chen & Guo, 1987; Chen *et al.*, 1999; Chen & Zhang, 2002; Luo *et al.*, 2000; Guo *et al.*, 2006; Zhang & Luo, 2010; Zhang *et al.*, 2011) were recorded in China. These species were mainly distributed in the south of Qinling Mountains and Yangtse River valley. In this paper, two species are reported as new to science *Boysidia* (*Boysidia*) *xianfengensis* **sp. nov.** and *B. (B.) xiaoguanensis* **sp. nov.** Six species were transferred from subgenus *Boysidia* (*Bensonella*) to subgenus *Boysidia* (*Boysidia*). Schileyko (1998) transferred *Boysidia* (*Bensonella*) *dilamellaris* Chen & Wu, 1995 to *Boysidia* (*Boysidia*), and transferred *Boysidia* (*Boysidia*) *fengxianensis* Chen & Wu, 1995 to the genus *Bensonella*. Those modification were followed in this paper, but *Bensonella* was treated as a subgenus of the genus *Boysidia* following Pilsbry's classification. The classification in this paper generally follows Pilsbry (1916–1918) and Baker (1935).

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2 Materials and methods

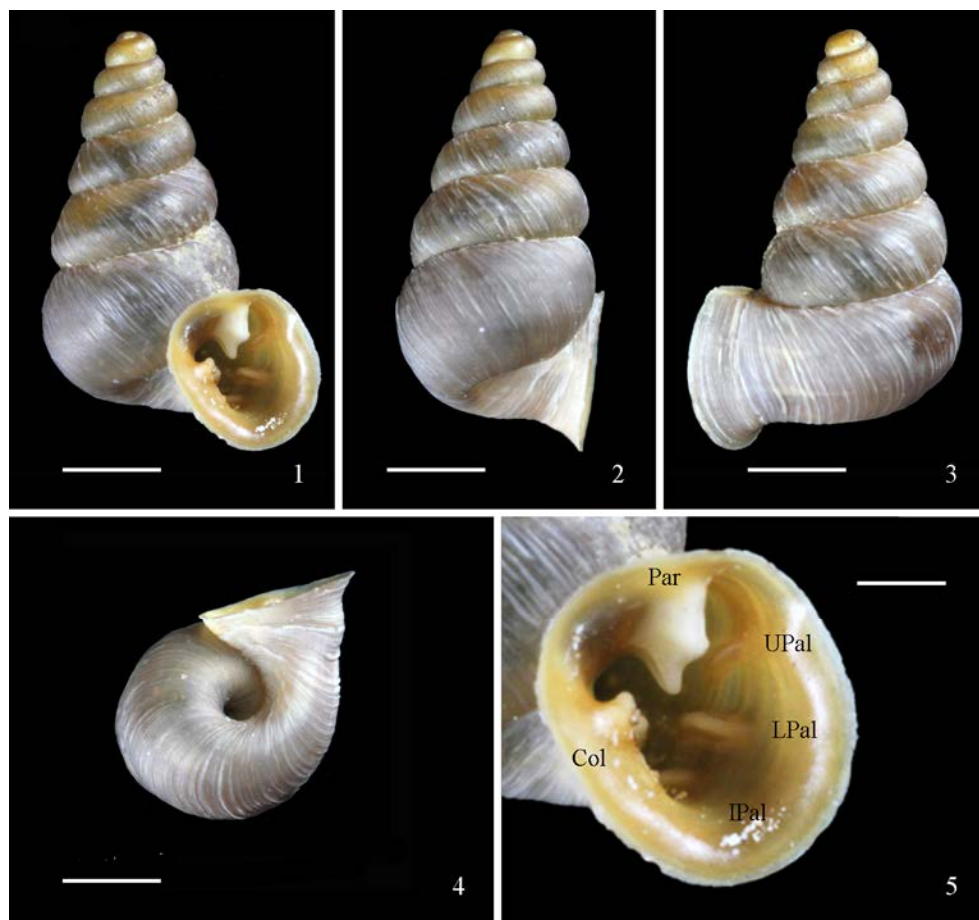
The snails were preserved in 70% ethanol. Forty-two shells of the two new species from adult snails were measured using an ocular micrometer to the nearest 0.01 mm. Shell dimensions of paratypes of the new species are described in this paper as: minimum–maximum (mean \pm standard deviation). Whorl numbers were counted as described by Kerney and Cameron (1979). The nomenclature of aperture barriers essentially follows Pilsbry (1916–1918) that is commonly applied to all pupilloids. Fauna component of China follows Zhang (1999).

Institutional abbreviation

IZCAS: Institute of Zoology, Chinese Academy of Sciences.

3 Zoogeographical distribution

The distribution and fauna component of all the known 23 species of the genus *Boysidia* from China were listed in Table 1 (Yen, 1939; Chen & Guo, 1987; Chen *et al.*, 1999; Chen & Zhang, 2002; Luo *et al.*, 2000; Guo *et al.*, 2006; Zhang & Luo, 2010; Zhang *et al.*, 2011). According to the table, *B. taibaiensis* is the northernmost distributed species (34°07'N, 107°18'E) in China. Most of Chinese *Boysidia* are distributed in the south of Yangtse River valley, belonging to south, central and southwest China. Few species are extended northwardly to Shanxi Province, belonging to North China. In 23



Figs 1–5. *Boysidia (Boysidia) xianfengensis* sp. nov. 1. Apertural view. 2. Right-lateral view. 3. Left-lateral view. 4. Umbilical view. 5. Aperture enlarged. Scale bars: 1–4 = 1 mm, 5 = 0.5 mm. Abbreviations: Par = parietal tooth; Col = columellar tooth; UPal = upper palatal tooth; LPal = lower palatal tooth; IPal = infrapalatal tooth.

species of *Boysidia*, 8 species, about 34.8% are distributed in southwest China; and 7 species, about 30.4% are distributed in central China; 4 species, about 17.4% in North China; 2 species, about 8.7% in South China. *B. strophostoma* is distributed both in south and central China. *B. gracilis* is distributed widely in central, southwest and North China. According to the distribution pattern, Chinese *Boysidia* is fundamentally an Oriental region group with a few Palearctic species. Most of Chinese species of genus *Boysidia* inhabit in warm limestone terrain, adhering to the surface of limestone rock, living in dark, moist places rich in lichen and bryophyte under fallen leaves or in dead wood (Chen & Guo, 1987; Chen & Zhang, 2002).

Table 1. List of Chinese *Boysidia* and its distribution records.

Species	Locality of collection ¹	Main areas of distribution ¹	Fauna component ²
Subgenus <i>Boysidia</i> (<i>Boysidia</i>) Pilsbry 1916			
<i>B. (Boysidia) dorsata</i> (Ancey, 1881)	g ₁	g	VI
<i>B. (Boysidia) hunana</i> (Gredler, 1881)	e ₁ , f ₁	e, f	VI
<i>B. (Boysidia) conspicua</i> (Moellendorff, 1885)	j ₂	j	VII
<i>B. (Boysidia) strophostoma</i> (Moellendorff, 1885)	j ₁ , i, f ₁ , e	i, j, e, f	VI, VII
<i>B. (Boysidia) hangchowensis</i> (Pilsbry & Hirase, 1908)	h ₁	h	VI
<i>B. (Boysidia) gracilis</i> Haas, 1937	e ₂ , b ₁ , a ₁	e, b, a	II, V, VI
<i>B. (Boysidia) guiyangensis</i> Luo & Chen, 1998	d ₃	d	V
<i>B. (Boysidia) dilamellaris</i> Chen & Wu, 1995*	a ₄	a	II
<i>B. (Boysidia) shilinensis</i> Chen & Wu, 1999*	c ₃	c	V
<i>B. (Boysidia) tianxingqiaoensis</i> Luo & Chen, 2000*	d ₂	d	V
<i>B. (Boysidia) tongguanensis</i> Chen & Zhang, 2002*	a ₅	a	II
<i>B. (Boysidia) xingyiensis</i> Guo & Zhou, 2006*	d ₅	d	V
<i>B. (Boysidia) xiuwenensis</i> Zhang & Luo, 2010*	d ₄	d	V
<i>B. (Boysidia) nanjiangensis</i> Zhang & Zhang, 2011*	d ₃	d	VII
<i>B. (Boysidia) pentadens</i> Chen & Wu, 1999	c ₁	c	V
<i>B. (Boysidia) xishanensis</i> Chen & Wu, 1999	c ₂	c	V
<i>B. (Boysidia) taibaiensis</i> Chen & Wu, 1999	a ₃	a	II
<i>B. (Boysidia) huangguoshuensis</i> Luo & Chen, 2000	d ₁	d	V
<i>B. (Boysidia) xiaoguanensis</i> sp. nov.	e ₄ , e ₅	e	VI
<i>B. (Boysidia) xianfengensis</i> sp. nov.	e ₃	e	VI
Subgenus <i>Boysidia</i> (<i>Bensonella</i>) Pilsbry, 1900			
<i>B. (Bensonella) plicidens</i> (Benson, 1849)	h ₁ , k ₁	h, k, l	VI
<i>B. (Bensonella) fengxianensis</i> Chen & Wu, 1995**	a ₂	a	II
Subgenus <i>Boysidia</i> (<i>Paraboysidia</i>) Pilsbry, 1917			
<i>B. (Paraboysidia) hupeana</i> (Gredler, 1901)	e ₂	e	VI

* The species was previously placed in subgenus *Boysidia* (*Bensonella*).

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1. a, Shanxi (a₁, Zhen; a₂, Fen; a₃, Taibai; a₄, Ankang; a₅, Tongguan); b, Sichuan (b₁, Wuxi and Youyang); c, Yunnan (c₁, Mengla; c₂, Kunming; c₃, Lunan); d, Guizhou (d₁, Huangguoshu, Zhenning; d₂, Tianxingqiao, Zhenning; d₃, Kaiyang; d₄, Xiuwen; d₅, Xingyi); e, Hubei (e₁, Xianfeng and Wudang mountain of Yangtse River valley; e₂, Badong; e₃, Xianfeng; e₄, Xuan'en; e₅, Enshi); f, Hunan (f₁, Northwest of Hunan); g, Jiangxi (g₁, Lake Poyang); h, Zhejiang (h₁, Hangzhou); i, Guangxi; j, Guangdong (j₁, Guangzhou; j₂, West river above Canton; j₃, Kaiyang); k, India; l, Japan.

2. II, north China; V, southwest China; VI, central China; VII, south China.

4 Description of new species

4.1 *Boysidia* (*Boysidia*) *xianfengensis* **sp. nov.** (Figs 1–5)

Holotype (IZCAS TM 136804), collected from Chengguan (29°06'N, 109°01'E), Xianfeng, Hubei, China, 15 August 1985.

Paratypes, 43 specimens (IZCAS TM 136789–136803, 136805–136832) (20 adult shells measured), collected from Chengguan, Xianfeng (29°06'N, 109°01'E), Hubei, China, 15 August 1985.

Etymology. The name of the new species refers the type locality of the new species, Xianfeng County.

Size. Shell height 4.85–4.95 mm (4.91 ± 0.13 mm), shell diameter 3.00–3.15 mm (3.09 ± 0.16 mm), height of aperture 1.40–1.48 mm (1.43 ± 0.07 mm), diameter of aperture 1.37–1.45 mm (1.41 ± 0.06 mm). Holotype. Shell height 4.90 mm, shell diameter 3.10 mm, height of aperture 1.45 mm, diameter of aperture 1.40 mm.

Description. Shell small, slightly thick, lustrous, elongated, conic. Whorls 7.5, moderately convex with high spire. Shell height about 1.57–1.61 times of width. Body whorl chestnut-brown in color, becoming yellowish brown gradually towards apex. Body whorl with oblique, thick and dense growth lines, especially distinct near the aperture, becoming weakened and sparse to the penultimate and the third last whorl, the remaining whorls smooth, without growth lines. Aperture elliptical, bell-formed, slightly oblique to the left. Peristome thick, slightly expanded and reflexed, separated from body whorl. Apex blunt. Sutures well impressed. Apertural teeth numbered five: angular and parietal lamellae united into one large elevated flake-shaped tooth (Par) reaching to the apertural margin; one long flake-formed columellar tooth (Col) reaching to the apertural margin; one small nipple-shaped upper palatal tooth (Upal) nearly on the apertural edge; one large moderately elevated oblique flake-shaped lower palatal tooth (Lpal) and one small infrapalatal tooth (Ipal) deep within the aperture. Umbilicus open, deep, cavity-shaped, but not showing previous whorl.

Habitat. The new species were found in dark and moist limestone locality with bryophyte and lichen, preferring to habit on the surface of limestone, or in chink of rock, under deadwood and fallen leaves.

Remarks. The new species is similar to *Boysidia* (*Boysidia*) *pentadens* Chen & Wu, 1999, but differs clearly by the shell characteristics. Shell of *B. xianfengensis* **sp. nov.** (height 4.90 mm, diameter 3.10 mm, $7\frac{1}{2}$ whorls) is larger than that of *B. pentadens* (height 3.40 mm, diameter 2.10 mm, $5\frac{1}{2}$ whorls). Five apertural teeth are bearing in both species. In *B. pentadens*, one large nipple-formed parietal lamella, one large columellar tooth, one punctiform upper palatal tooth, one large lower palatal tooth and one small basal tooth are present, while instead of the basal tooth with a small infrapalatal tooth in *B. xianfengensis* **sp. nov.** Moreover, the umbilicus is small in *B. pentadens*, but open in *B. xianfengensis* **sp. nov.**

Additionally, *Boysidia* (*Boysidia*) *hangchowensis* (Pilsbry & Hirase, 1908) and *B. (B.) hunana* (Gredler, 1881) (Heude, 1882–1885) also have 5 apertural barriers, but have columellar teeth downwardly curved, rather than straight in *B. xianfengensis* **sp. nov.** and *B. pentadens*.

4.2 *Boysidia* (*Boysidia*) *xiaoguanensis* **sp. nov.** (Figs 6–10)

Holotype (IZCAS TM 129969), collected from Xiaoguan (29°56'N, 109°20'E), Xuan'en, Hubei, China, 17 June 1984.

Paratypes, 40 specimens (20 adult shells were measured), collected from Xiaoguan (29°56'N, 109°20'E; IZCAS TM 129960–129968, 129970–130015), Xuan'en, 17 June 1984 and Chengguan (30°02'N, 109°28'E; IZCAS TM 101767–101681), Enshi, Hubei, China, 12 August 1985.

Etymology. The name of the new species refers the type locality of the new species, Xiaoguan Town.

Size. Shell height 3.41–3.61 mm (3.50 ± 0.11 mm), shell diameter 2.15–2.20 mm (2.20 ± 0.14 mm), height of aperture 1.07–1.14 mm (1.10 ± 0.07 mm), diameter of aperture 0.98–1.08 mm (1.03 ± 0.08 mm). Holotype. Shell height 3.55 mm, shell diameter 2.20 mm, height of aperture 1.10 mm, diameter of aperture 1.05 mm,

Description. Shell small, slightly thick, lustrous, elongated, conic. Whorls 5.5–6.5, moderately convex with high spire. Shell height about 1.59–1.64 times of width. Shell color chestnut-brown becoming yellowish brown towards apex. Shell surface with oblique slender and dense growth lines, becoming weakened towards apex. Embryonic whorls numbered 1–2, increasing slowly, smooth. Apex blunt. Sutures deep. Peristome separated from body whorl. Aperture elliptical, bell-formed, thick, slightly expanded and reflexed, slightly oblique to the left, with 4 teeth. Angular and parietal lamellae fused into one large elevated flake-shaped tooth (Par) reaching to the apertural margin, one long flake-shaped columellar tooth (Col) reaching to the apertural margin, one large moderately elevated flake-shaped upper palatal tooth (Upal) nearly reaching to the apertural margin, one slightly small moderately elevated flake-shaped lower palatal tooth (Lpal) deep within the aperture. Three plicate lines visible in the left side of the last whorl, one plicate line visible in umbilicus. Umbilicus slightly big, cavity-shaped. Columellar margin not covering umbilicus.



Figs 6–10. *Boysidia (Boysidia) xiaoguanensis* **sp. nov.** 6. Apertural view. 7. Right-lateral view. 8. Left-lateral view. 9. Umbilical view. 10. Aperture enlarged. Scale bars: 6–9 = 1 mm, 10 = 0.5 mm. Abbreviations: Par = parietal tooth; Col = columellar tooth; UPal = upper palatal tooth; LPal = lower palatal tooth.

Habitat. The snail lives in limestone area, habits on the surface of limestone, in moist locality with bryophyte and lichen; or lives in chink of rock, under fallen leaves and rotten branch.

Remarks. The new species is very close to *Boysidia (Boysidia) xishanensis* Chen & Wu, 1999, but differs clearly by the shell characteristics. Shell of *B. xishanensis* (height 2.75 mm, diameter 1.5 mm) is smaller than that of *B. xiaoguanensis* **sp. nov.** (height 3.55 mm, diameter 2.20 mm). Four apertural teeth are bearing in both species. But *B. Xishanensis* has a slightly large, nipple-shaped infrapalatal tooth, without the lower palatal tooth, and its upper palatal tooth is smaller than that of *B. xiaoguanensis* **sp. nov.** Moreover, the umbilicus is small in *B. xishanensis*, but slightly big in *B. xiaoguanensis* **sp. nov.**

Among Chinese species of *Boysidia (Boysidia)*, *B. (B.) taibainensis* Chen & Wu, 1999 and *B. (B.) huangguoshuensis* Luo & Chen, 2000 also have four same kind apertural teeth, but the size and shape of teeth are different from the new species. *B. taibaiensis* has a flake-shaped, bilobed angular-parietal tooth, one small nipple-shaped upper palatal tooth and one medium size nipple-shaped lower palatal tooth. Angular-parietal tooth and columellar tooth of *B. huangguoshuensis* are large and flake-shaped, and upper and lower palatal teeth are small and nipple-shaped.

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